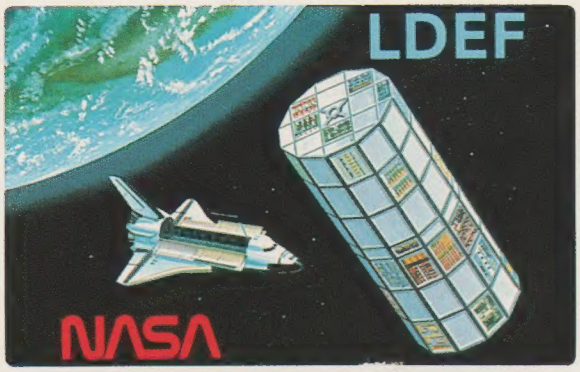
THE USER'S GUIDE TO VERTICAL PAYLOAD PROCESSING

NASA

National Aeronautics and
Space Administration

John F. Kennedy Space Center


LDEF
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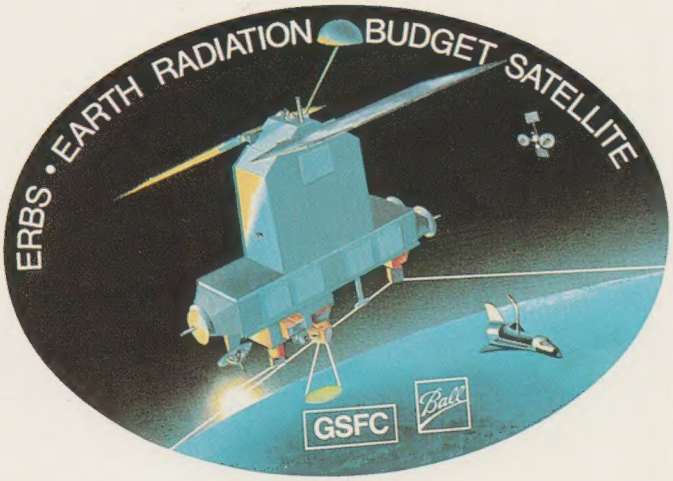
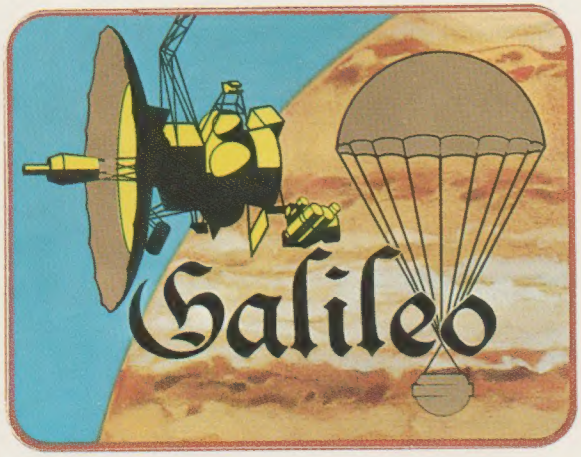
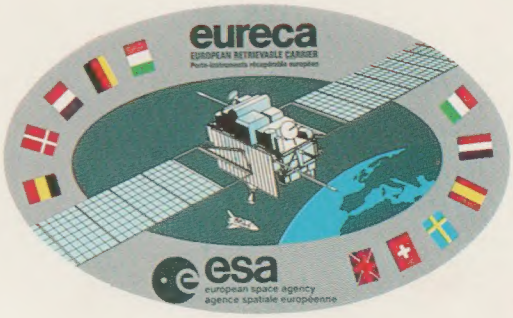
SMALL SELF-CONTAINED
NASA
GET AWAY SPECIAL
PAYLOADS


ERBS • EARTH RADIATION BUDGET SATELLITE
GSFC
Ball


WESTAR VI
western union


Galileo


eureca
EUROPEAN RETRIEVABLE CARRIER
esa
european space agency
agence spatiale européenne

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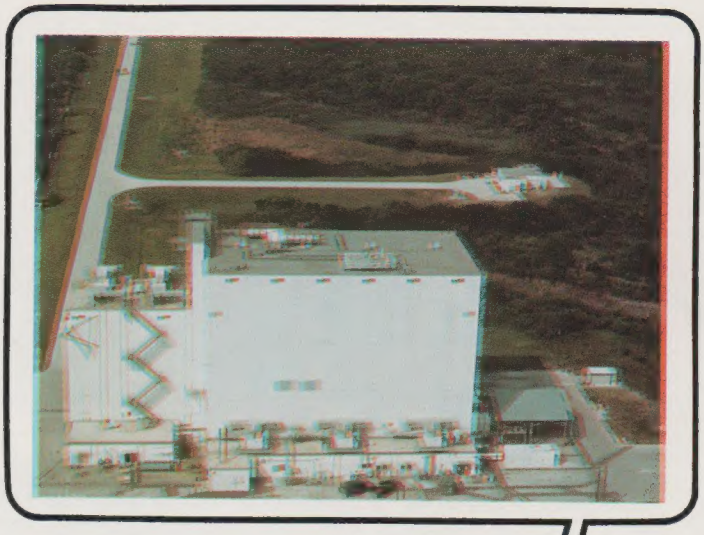
February 1984

Right: The Vertical Processing Facility - the focal point of the vertical integration process.

Below: The KSC Industrial Area looking east with Cape Canaveral Air Force Station in view across the Banana River.



Contents

The Kennedy Space Center (KSC) is the primary launch and landing site for the Space Transportation System (STS), more commonly known as the Space Shuttle. KSC is also responsible for final checkout, preparation, and loading of payloads in the Orbiter vehicle before launch and deintegration of payloads upon their return from space. **The User's Guide to Vertical Payload Processing** is intended to provide you, a potential user of the Space Shuttle, with a basic understanding of payload facilities, services, ground support equipment, and operations involved in the processing of your flight hardware at KSC. The illustration on page 6 describes the STS payload processing classifications, special categories, and processing flows.

Throughout this guide, emphasis is placed on a fundamental exchange of information necessary for the efficient and economical use of the Space Shuttle. Your need, as a payload developer, is to be aware of support services and capabilities available at KSC. As the center responsible for all STS payload integration, KSC needs the early identification of any special support you may require. Ensuring the necessary lead time for modification and/or procurement and avoiding equipment and service conflicts with other payload processing flows are major concerns.

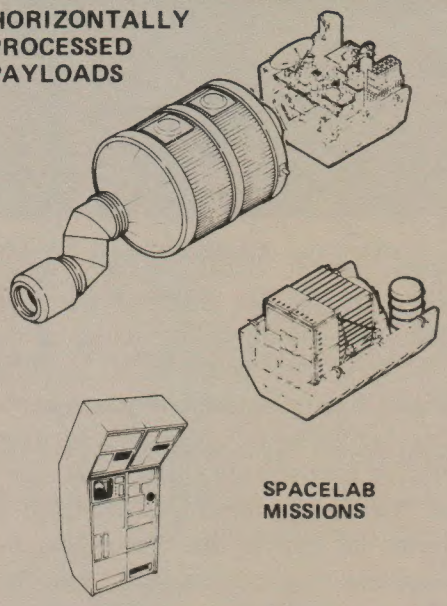
Your primary contact at KSC will be your Launch Site Support Manager (LSSM), who will give you any assistance and guidance necessary in order to process your payload.

It is our hope that the 'head start' information presented in the following pages will help give you an initial insight into the operations necessary to prepare your payload for flight.

The **User's Guide to Vertical Payload Processing** is prepared and published by the Cargo Projects Office of the NASA John F. Kennedy Space Center for payload designers and developers, engineers, managers, and STS users participating in prelaunch operations at KSC. Additional copies of this document may be obtained by writing: **User's Guide to Vertical Payload Processing,** CP-FSO, Kennedy Space Center, Florida 32899, U.S.A.

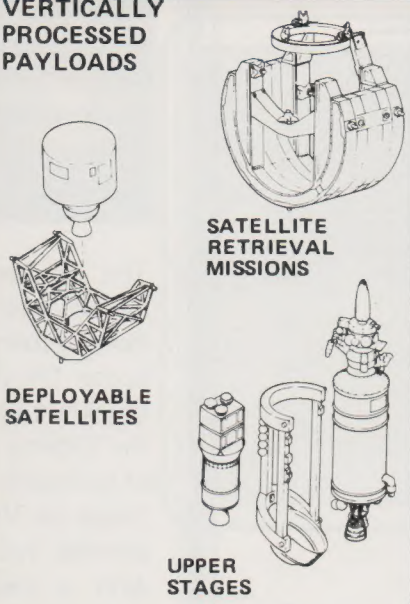
STS PAYLOADS PROCESSING CLASSIFICATIONS

HORIZONTALLY PROCESSED PAYLOADS



SPACELAB MISSIONS

VERTICALLY PROCESSED PAYLOADS

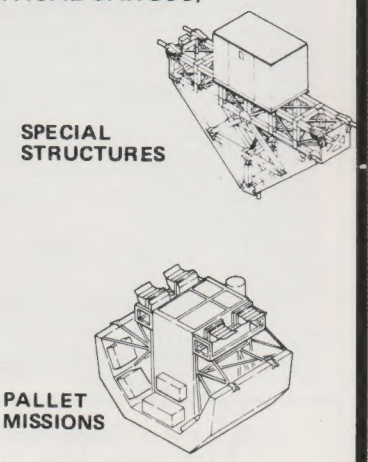


SATELLITE RETRIEVAL MISSIONS

DEPLOYABLE SATELLITES

UPPER STAGES

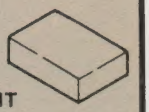
MIXED CARGOS (HORIZONTALLY PROCESSED PAYLOADS WHICH ARE INTEGRATED WITH VERTICAL CARGOS)



SPECIAL STRUCTURES

PALLET MISSIONS

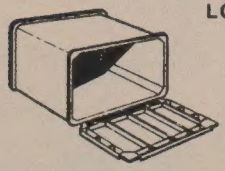
SPECIAL CATEGORIES



SHUTTLE STUDENT INVOLVEMENT PROJECT

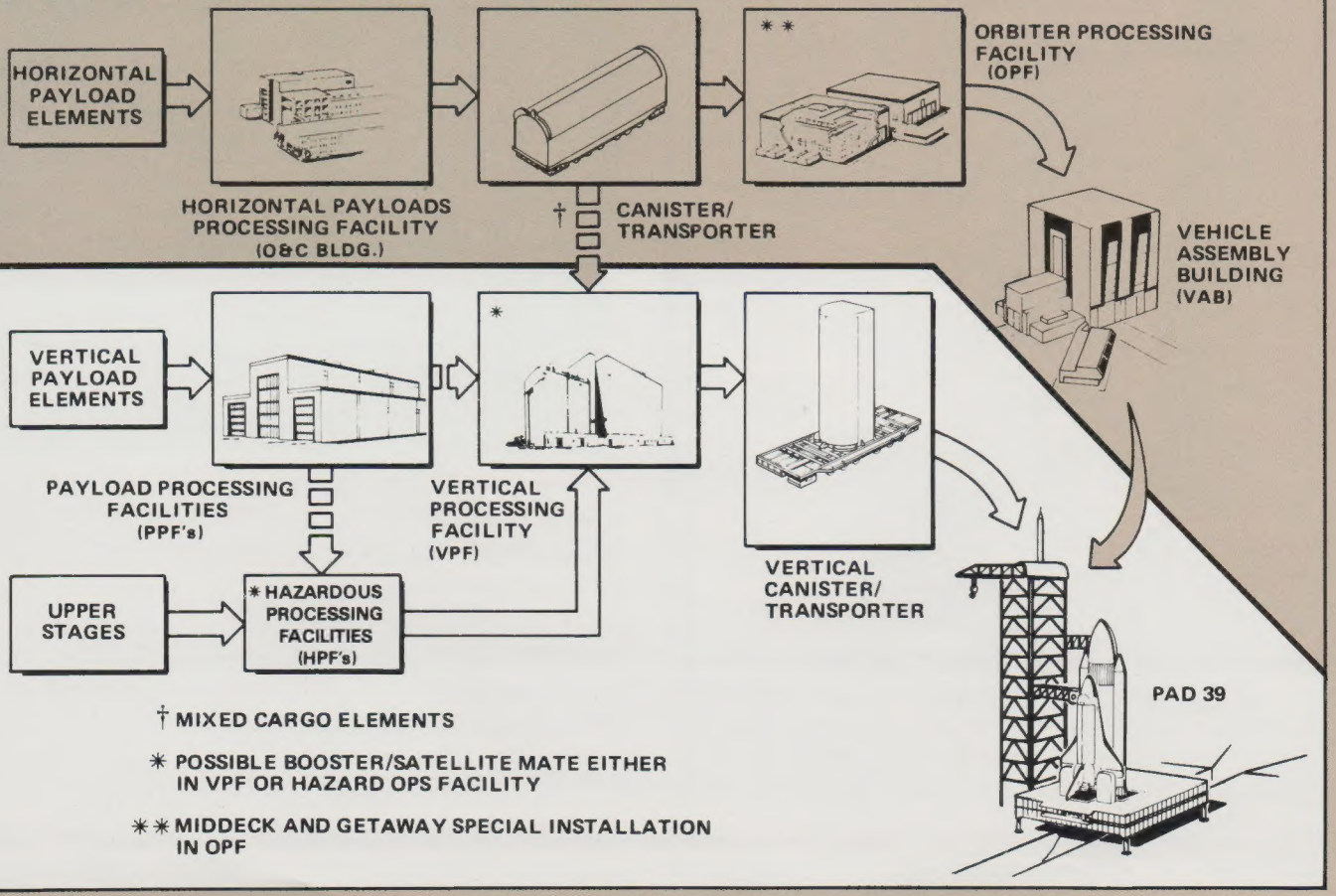
GETAWAY SPECIAL PAYLOADS

MIDDECK EQUIPMENT



MIDDECK LOCKERS

PAYLOAD PROCESSING FLOWS AT KSC



SECTION ONE: I
PREPARATION OF VERTICALLY PROCESSED PAYLOADS FOR FLIGHT

OVERVIEW

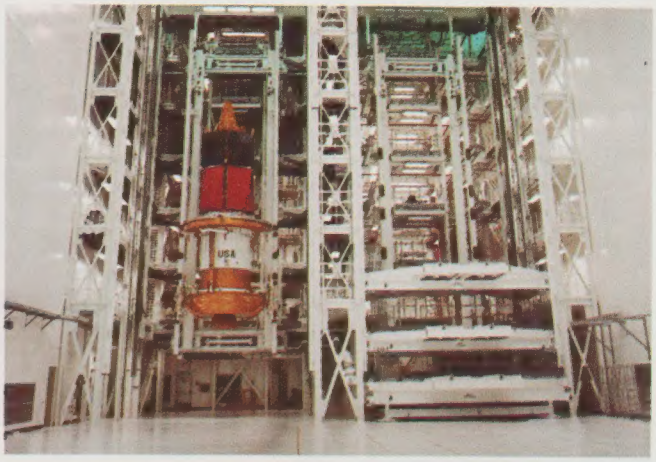
Vertically processed payloads are normally received at one of the following Payload Processing Facilities (PPFs): Buildings AE, AO, AM, and Hangar S at Cape Canaveral Air Force Station (CCAFS); Spacecraft Assembly and Encapsulation Facility No. 2 (SAEF-2), located in the KSC Industrial Area, or a future Cargo Hazardous Servicing Facility (CHSF) to be located in the KSC Industrial Area. (The latter two facilities function as either a PPF or a hazardous facility). A map of the KSC area is shown on page 8 and the facilities are shown in the Cargo/Payload Facilities illustration on page 9. Normal PPF activities include the reassembly and checkout of payload elements and systems to assure a flight ready payload.

If hazardous operations are required, the payload or upper stage is moved to a Hazardous Processing Facility (HPF) where operations are conducted by the STS user with assistance by KSC.

> An operation may be classified as hazardous by KSC Safety if it involves stored energy, materials, or an environment in which loss of control could result in injury to personnel or damage to equipment.

If no hazardous operations are necessary, the payload goes directly to the Vertical Processing Facility (VPF).

Processing of upper stages and payloads within the VPF will vary depending upon the type of payload and/or upper stage involved. The initial phase of VPF operations generally consists of receiving, inspecting, and installing the payload and/or upper stage into a Vertical Payload Handling Device (VPHD). Once all the payload elements which require a simulated Orbiter interface test are installed in the VPHD, testing is conducted using Cargo Integration Test Equipment (CITE). This equipment simulates the appropriate Orbiter interfaces. Once the CITE testing is completed, post-CITE operations may be performed to close out the cargo in preparation for moving in the canister/transporter to the pad.

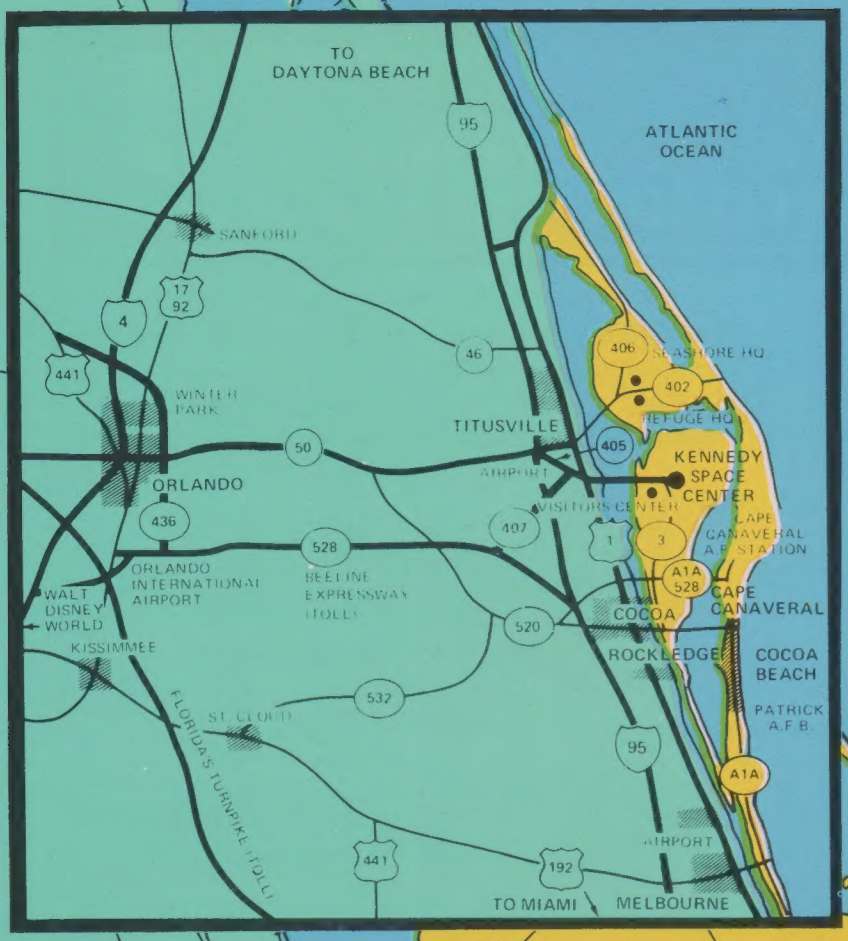


Inertial Upper Stage (IUS) and Tracking Data Relay (TDRS) in a VPF workstand.

At this point, the Orbiter has already been through the Orbiter Processing Facility (OPF) where share-the-flight cargo such as Get-Away Specials (GAS) or a horizontally processed payload has been installed in the cargo bay. The Orbiter is then moved to the Vehicle Assembly Building (VAB), where it is mated with the External Tank (ET) and Solid Rocket Boosters (SRBs), then moved to the pad on the Mobile Launch Platform (MLP).

The canister is positioned under the Rotating Service Structure (RSS), hoisted to the proper elevation, and locked into place against the Payload Changeout Room (PCR) of the RSS. The Payload Ground Handling Mechanism (PGHM) then removes the cargo from the canister, retracts into the PCR, and installs it into the Orbiter after the canister and transporter have been removed and the RSS positioned against the Orbiter. The cargo is now connected to the appropriate Orbiter interface. Vertification testing, final checkout, and servicing are then conducted.

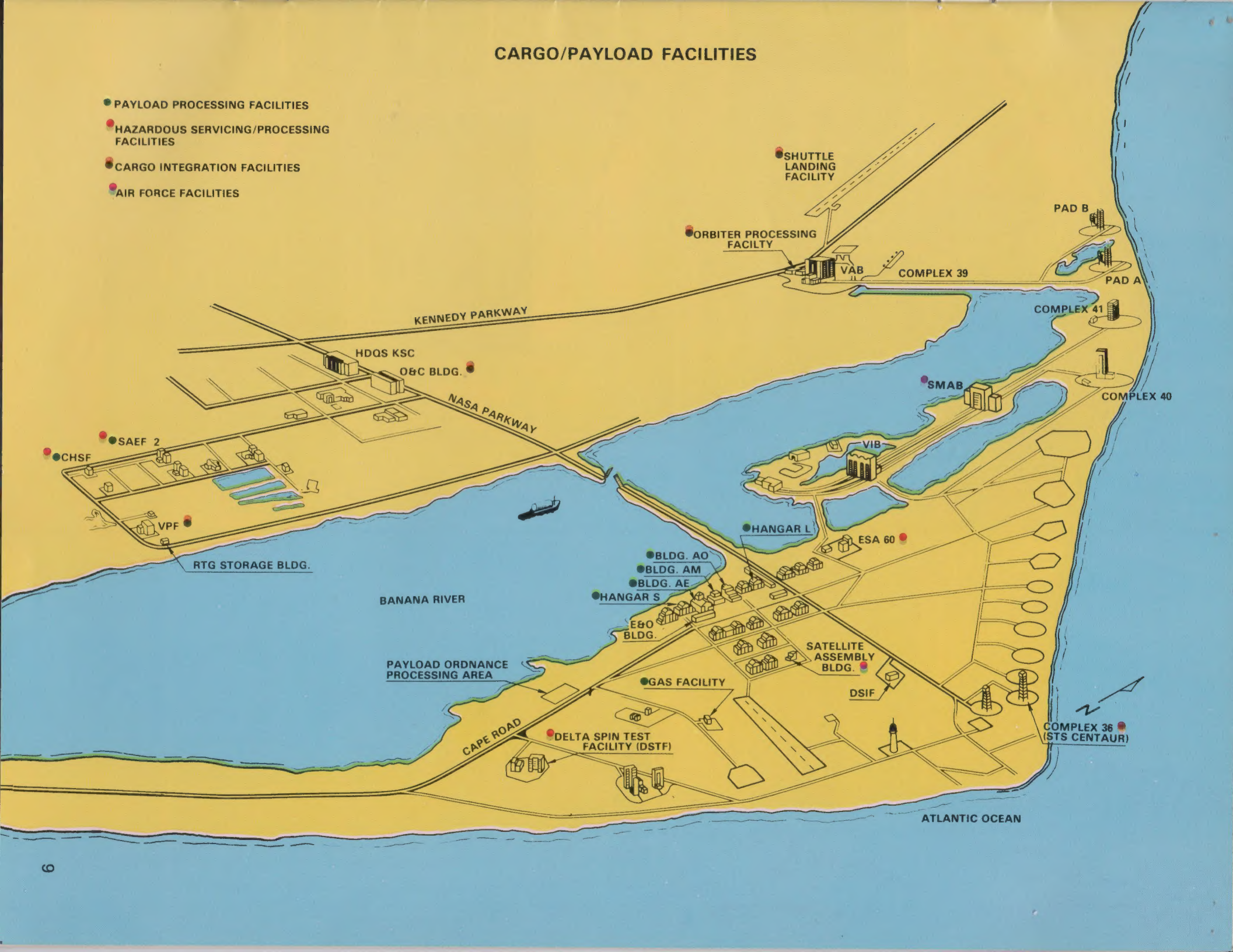
The diagram on pages 10 and 11 illustrates the flow for Cargo Processing at KSC.



ATLANTIC OCEAN

I-95
US1
406
402
GATE 4
398
MERRIT ISLAND
406
39A
TITUSVILLE
41
405
VAB
INDIAN RIVER
KENNEDY SPACE CENTER
40
50
50
KSC INDUSTRIAL AREA
37
405
ITL
407
GATE 3
NASA PARKWAY
VIC
34
I-95
19
TICO AIRPORT
USB
KENNEDY PARKWAY
14
GATE 2
36
BANANA RIVER
17
SR 3
5 6 & 26
CAPE CANAVERAL AIR FORCE STATION
GATE 1
US 1
TRIDENT
528
PORT CANAVERAL
528
BENNETT CAUSEWAY
524

CARGO/PAYLOAD FACILITIES



SOLID MOTOR
ASSEMBLY BUILDING

CARG

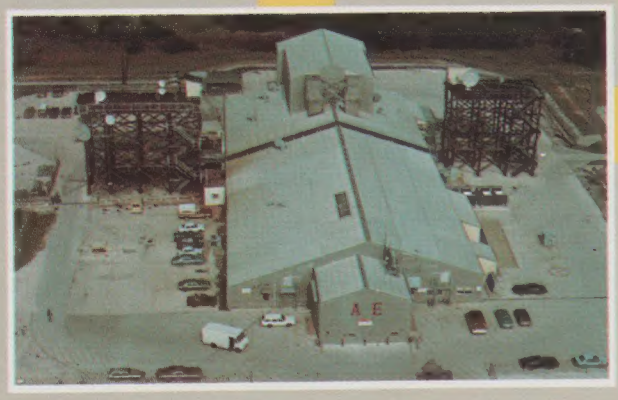
VERTICAL PROCESSING

INCOMING
PAYLOADS
AND UPPER
STAGES

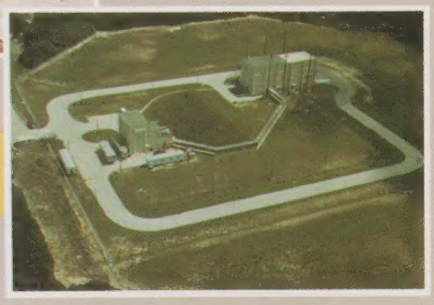
LAUNCH
COMPLEX 36

ASSEMBLED
CENTAUR STAGE

EXPLOSIVE SAFE AREA-60



PAYLOAD PROCESSING FACILITY



DELTA SPI

CANIST

HORIZONTAL PROCESSING

INCOMING/RETURNED
PAYLOADS/FLIGHT SUPPORT
ELEMENTS

OPERATIONS AND CHECKOUT BUILDING

PROCESSING FLOW

LAUNCH
COMPLEX 39

MBLED INERTIAL
R STAGE

CANISTER/TRANSPORTER

VERTICAL
PROCESSING
FACILITY

ORBITAL OPERATIONS

VEHICLE ASSEMBLY
BUILDING AND LAUNCH
CONTROL CENTER

AYLOAD
LE/PAYLOAD

MIXED
CARGO

ST FACILITY

RANSPORTER

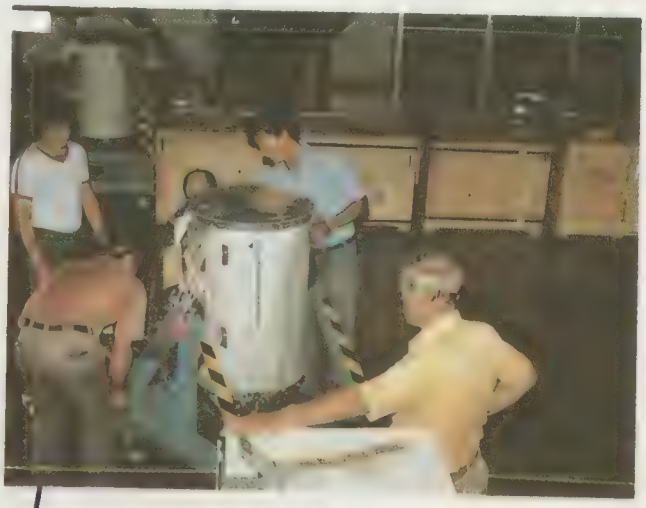
LANDING

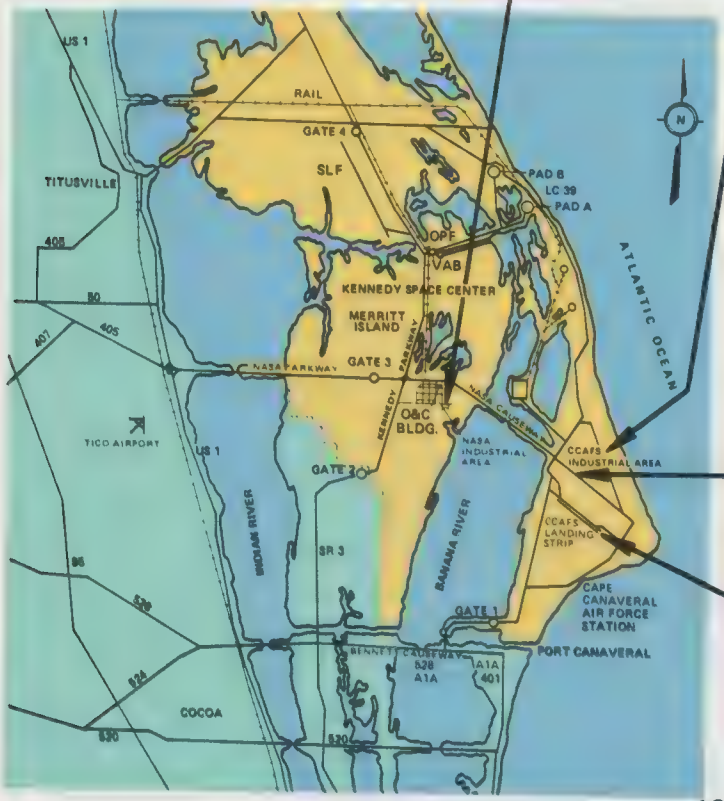
ORBITER PROCESSING FACILITY

ARRIVAL & RECEIVING 1

Your payload and attendant ground support equipment (GSE) can be delivered to KSC via air, sea, or land. In addition to major highways and an onsite rail spur, barge docks are located on the Banana River, and there is an international seaport of entry at Port Canaveral. Foreign and domestic shipments may be flown into the Orlando International Airport, about 1 hour from KSC by road. U.S. Customs Service can be provided at KSC or the CCAFS landing facilities, if arrangements are made in advance. Transportation to a PPF is the responsibility of the payload owner.

The processing flow begins when your payload and GSE arrive at one of the existing PPFs. The first step is receiving and inspection. The initial inspection is intended to identify any visible shipping damage. Responsibility for detailed inspection rests with the payload owner when equipment is unpacked in the designated area in the PPF.





PAYLOAD PREPARATION 2

After your receiving inspection has been completed in the PPF, you can begin the final assembly/buildup of your payload to its launch configuration. This could include the installation of solar panels, antennas, and other items that were shipped separately to the launch site. This assembly does not include operations involving ordnance, cryogens, or hypergols, but can include initial pressure system tests and propellant system leak tests. You may now conduct payload functional testing with all your payload-unique ground checkout equipment. During this preintegration phase, minor repairs are possible, and electrcial and mechanical repair and fabrication facilities are available.

PPF testing of the Shuttle Pallet Satellite (SPAS)-01.

Storage space is available. There is ample outdoor storage; however, you should recognize that the coastal environment is highly corrosive.

Because indoor storage, especially that which is environmentally controlled, is extremely limited at KSC, it is essential that your storage requirements be identified to your LSSM as early as possible.

Once the PPF operations have been completed, your payload must be transported to an HPF if hazardous operations are required. However, for payloads not requiring hazardous operations or an upper stage, you may go directly from the PPF to the VPF.

If the flight is going to include a horizontally processed payload element, a mixed cargo results. The horizontal elements such as a pallet, Mission Peculiar Experiment Support Structure (MPESS) or other special structures are generally integrated with their experiments in the O&C Builidng assembly and test area. After experiment integration, the pallet with its integrated experiments is placed in the payload canister on the transporter and moved to the VAB for rotation of the canister with its payload and then transported to the VPF where it joins the remainder of the cargo.

Some payloads may go directly to the pad after VAB canister rotation, bypassing the VPF if CITE testing is performed in the O&C Building or by waiver approval.

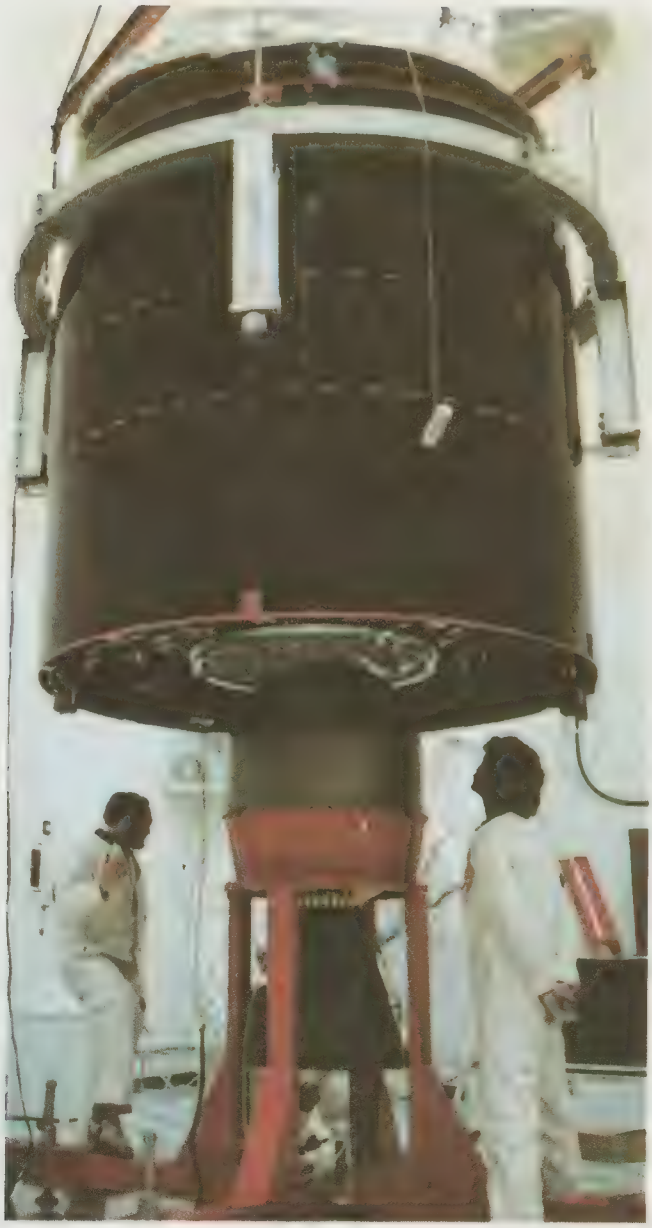
Canister rotation in the VAB.

PAYLOAD HAZARDOUS PROCESSING

3

Two facilities on CCAFS, the Delta Spin Test Facility (DSTF) and the Explosive Safe Area 60A (ESA-60A), as well as the SAEF-2 at KSC handle vertical payloads at the point in their processing in which hazardous operations are involved. A new CHSF is planned for early 1986.

Typical hazardous operations include liquid mono/bi-propellant loading, installations of solid propellant apogee motors or ordnance separation devices, and other potentially explosive or hazardous items.



ANIK-C2 spacecraft Apogee Kick Motor installation.

Removal of environmental cover from an assembled PAM-D and spacecraft in the VPF.

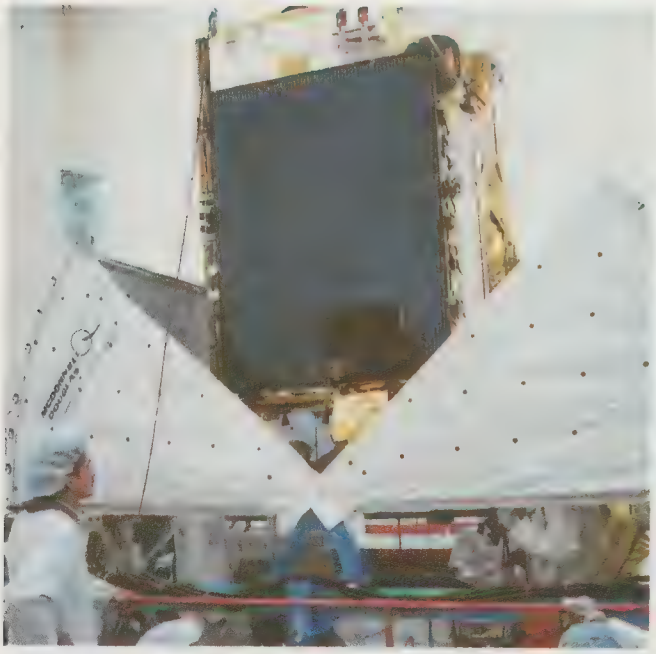
After assembly, checkout, and hazardous operations have been completed, the heavier payloads requiring an Inertial Upper Stage (IUS) or larger upper stage will be transported to the VPF for mating with their respective upper stage.

UPPER STAGE PROCESSING (CENTAUR, IUS, TOS, PAM)

4

The DSTF, ESA-60A, SAEF-2, and CHSF HPFs are also used to process the upper stage elements for their independent operations at KSC. The HPF operations associated with upper stage processing are assembly, spin balancing, ordnance installation, interface testing with cradles or airborne support equipment, and final mating with payloads. In addition, the Missile Research & Test Building and the Non-Destructive Test Lab may be used to perform cold soak testing and X-ray checks of the solid motors prior to final assembly into flight configuration.

Upper stages in descending order of size are: the liquid cryogen fueled Centaur being planned; the solid propellant stages such as: the IUS developed by the U.S. Air Force for both itself and NASA; the planned Transfer Orbit Stage (TOS); and the Payload Assist Module (PAM DII or PAM D).



INSAT satellite being mated to a PAM.

After receiving and inspection, the Centaur will undergo testing at Complex 36 to verify the cryo loading system and functional operation of flight components prior to moving to the VPF. Assembly and testing of an IUS upper stage are performed

IUS being mated to a TDRS.

in the east low bay of the Solid Motor Assembly Building at CCAFS prior to transfer to the VPF for mating and testing with the payload.

Following the payload owners hazardous operations, the payloads that utilize a (PAM D or DII) stage will be moved to ESA-60A north bay where they will be mated to the booster/cradle assembly, sun shields will be installed, and a system checkout performed. The payload/booster is then prepared for transport and placed in the PAM transporter for its trip to the VPF.

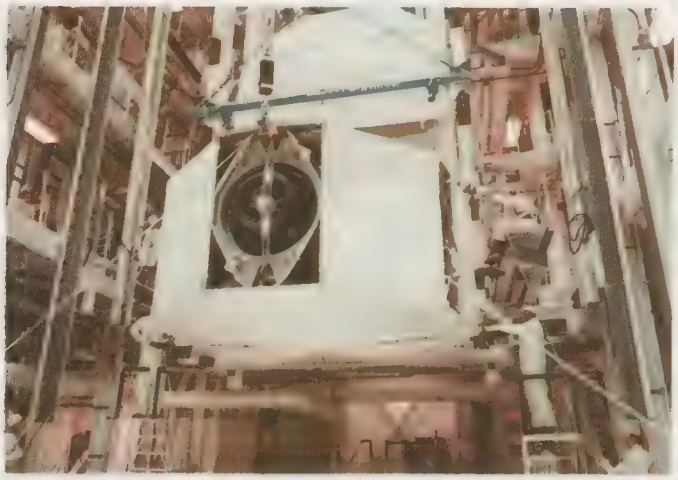
Upper stage delivery to the VPF.

CARGO INTEGRATION & CITE TESTING

5

Upon arrival of payloads and upper stages at the VPF, their transporters, environmental covers or containers, and hoisting fixtures undergo cleaning operations on the concrete apron south of the building with final cleaning in the airlock. Processing of upper stages and payloads within the VPF may vary depending on the type of upper stage involved.

A PAM with mated payload is moved into the high bay and the environmental cover removed. After visual inspection, the PAM payload is rotated in its handling frame, then hoisted into the VPHD. A payload without an upper stage is installed in the same manner.



PAM and mated payload being installed in a VPHD at the VPF.

Larger upper stages are hoisted into the VPHD and both KSC and user-provided access equipment is installed to facilitate access for payload mating to the stages.

> It is the user's responsibility to rotate the payload to the correct orientation for installation into the VPHD and to provide any payload peculiar hoisting gear.

Payloads and upper stages may conduct stand-alone health and status tests utilizing user portable test equipment or remote ground checkout equipment prior to CITE testing.

The CITE is a set of KSC hardware and software that simulate all payload interfaces with the Orbiter. CITE tests allow a compatibility check prior to entering the Space Shuttle flow at the pad.

A series of CITE tests, starting with an interface verification test, are conducted to verify all hardware interfaces including redundant paths. The payload owners participate in these tests which are controlled from a CITE control room located in the O&C Building. Orbiter Aft Flight Deck functions to the payload are provided from an Aft Flight Deck Simulator Console located at the top of the VPF workstands.

Most normal and some contingency mission functions are exercised in the mission sequence simulation test in which data, formats, and command paths are verified; however, solar panels and antennas will not be deployed.

If required, an end-to-end test will be conducted as an optional service. This test provides the opportunity to verify all command and data links between the Orbiter/upper stage/payload, and the payload ground stations engaged in the mission.

End-to-end testing being monitored from the Aft Flight Deck Console simulator.

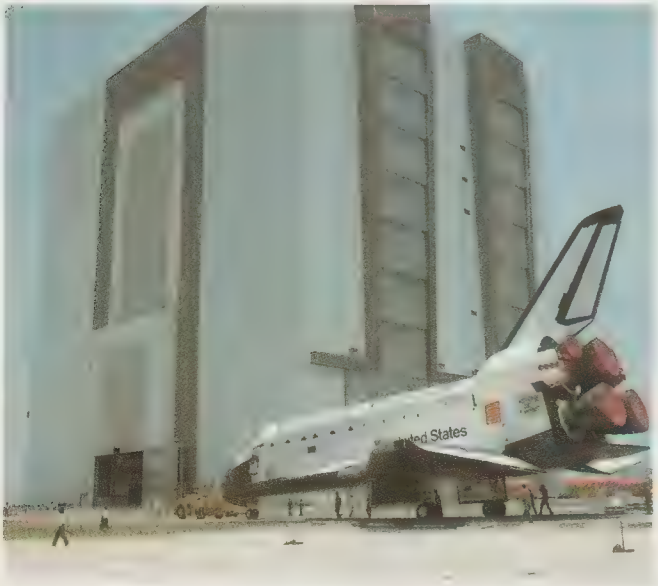
Once these tests are completed, an ordnance systems test is performed, including items such as safe and arm rotation and stray voltage tests. Following this, closeout activities begin and the cargo is readied for its trip to the pad.

ORBITER OPERATIONS 6

While the cargo is being readied in the VPF, the Orbiter is being reserviced in the OPF. The GAS payloads and some non-time-critical middeck payloads are installed in the Orbiter at this point. The GAS payloads are assembled and checked out in the GAS processing facility, transported to the OPF, and installed in the Orbiter on a GAS adapter beam or bridge structure.

Getaway Special installation in the Orbiter bay on an adapter beam.

Once the Orbiter checkout with any payloads installed in the OPF is completed, it is towed to the VAB where it is mated with the ET and the SRBs on the MLP.



Orbiter being towed to VAB from OPF.

STS integration in the VAB.

The Orbiter connections to the MLP through the Tail Service Mast are then verified as well as Orbiter to ET and SRB interfaces. The crawler is positioned under the MLP, lifts it and carries the MLP, SRB, ET, and Orbiter on its three mile trip to the launch pad. Once there, the MLP is placed "hard-down" and connections to the launch pad are verified.

The STS vehicle is moved to the pad.

VPF TO PAD OPERATIONS 7

Back in the VPF in preparation for transfer, the VPF platforms are moved to the top of the workstand, the pre-configured canister and transporter positioned at the VPHD, and the entire cargo transferred into the canister. Those payloads requiring specific services (instrumentation, monitor, fluids and gases, and electrical power) are connected to the canister supporting subsystems. Subsystems are activated, services verified, unique access gear removed, and the VPHD and workstand planks are retracted. The canister is moved clear of the VPHD and workstand, and the canister doors closed. The canister Environmental Control System is then activated.

Cargo after being installed in the canister at the VPF.

The transporter cab is manned for continuous monitoring of instrument functions, services, and canister road status. Using facility power through an extension cable, the transporter/canister is moved through the airlock high bay doorway into the airlock and the high bay door is closed to preserve the high bay clean room status. The airlock external door is opened next and the transporter/canister is moved outside the airlock. (This movement is contingent on compatible weather conditions and the time of day selected is during a low traffic period.) The facility power extension is disconnected, the airlock door closed, and the integral electrical power system and prime mover power systems activated.

Canister being closed on the transporter in preparation for move from the VPF to the pad.

KSC security and fire personnel and contingency-access payload user and cargo integration personnel accompany the move. The transporter is driven at a speed not exceeding 5 miles per hour (8.05 km per hour) to launch pad 39A or 39B. The canister remains vertical on the approach up the pad ramp to the RSS by use of the transporter self-leveling system. The cansister is precisely positioned under the RSS by moving the transporter to a marked 'park' position.

RSS & PCR OPERATIONS 8

The RSS is the movable, gantry-like structure located on the launch pad. The PCR is part of the RSS and functions as an airlock and clean work area when the cargo is inserted into or removed from the Orbiter as it maintains the controlled environment required by the cargo and the Orbiter bay. The PGHM is an integral part of the PCR and handles all cargo movements from canister to PCR and PCR to the Orbiter.

Upon arrival at the RSS, the payloads are considered on-line Shuttle. Payload GSE required to support launch pad operations can be installed within the PCR, the MLP Room 10A, or the Pad Terminal Connection Room as required.

Installation of the vertical payloads into the PCR occurs normally before the Shuttle transfer to the launch pad, and begins with the positioning of the canister below the retracted RSS. The Canister is hoisted to the proper elevation, locked into position, and the environmental seals of the room inflated against the sides of the canister. The space between the closed doors of the PCR and the canister is purged with clean air to ensure the required cleanliness, and the doors of the PCR and then the canister are opened.

Canister positioned in the RSS.

The PGHM is moved to the canister; the attach/handling fittings of the PGHM are aligned and attached to the cargo. The PGHM is retracted into the PCR carrying the cargo. The canister doors and the PCR doors are then closed. The canister is lowered to the transporter and taken to the storage facility.

Eight hours of cargo stand-alone testing (to be shared among payload elements) in the RSS are available, if desired. All payload servicing is accomplished before installation into the Orbiter, if feasible.

Cargo being installed in the Orbiter bay by the PGHM.

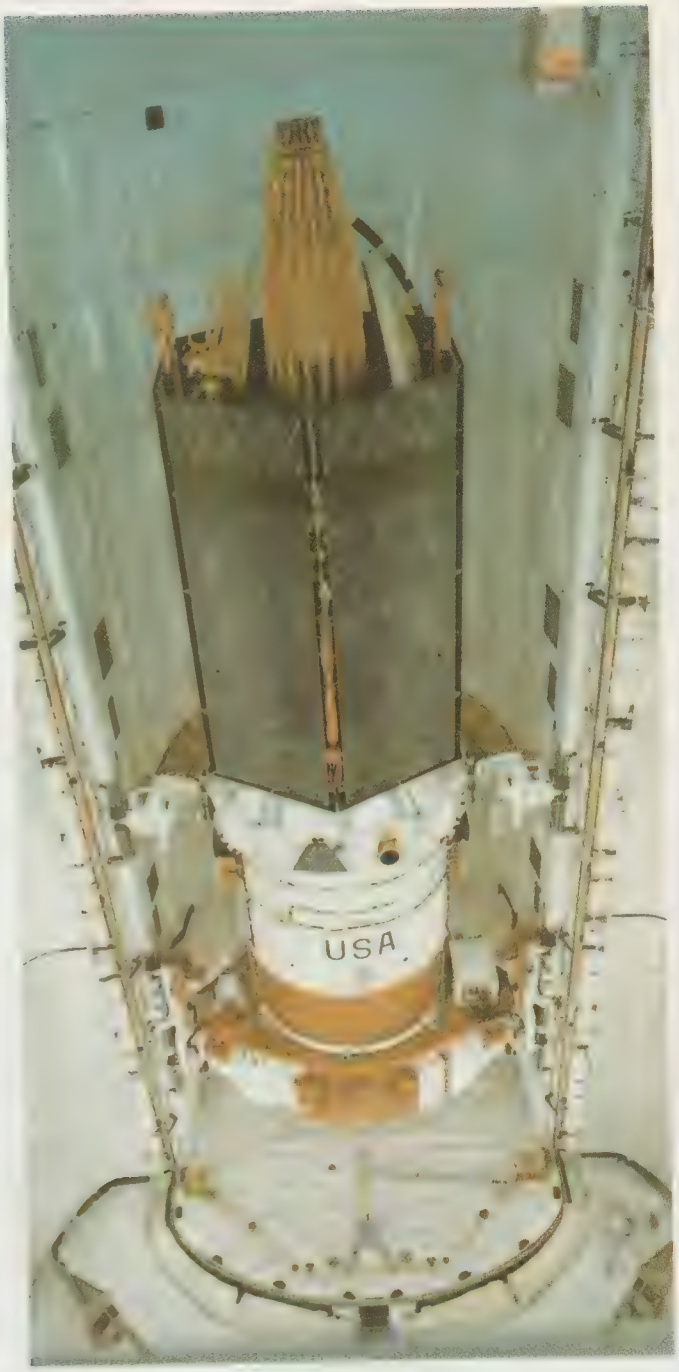
The RSS is then moved into position to enclose the Orbiter cargo bay and environmental seals are established. The space between the closed Orbiter and PCR doors is purged with clean air. The PCR doors are opened and the cargo bay doors are opened. The PGHM then extends the cargo into the Orbiter.

ORBITER INTEGRATION 9

Once the cargo has been installed in the Orbiter payload bay by the PGHM, the cables to the Orbiter are mated and interface verification testing is begun. All testing of the cargo in the payload bay is done from one of the firing rooms at the Launch Control Center (LCC). It is possible for payload personnel to monitor these tests from the Launch Processing System (LPS) consoles in the LCC or the payload user's ground checkout station consoles located in the PPF (if prearranged). The LPS hardware and software allows monitoring of only the Orbiter General Purpose Computer payload information telemetered through Orbiter systems.

Prelaunch checkout and test are conducted from the LCC.

If it is required, an end-to-end test will be performed in the payload bay as an optional service. This includes the Johnson Space Center Mission Control Center, the user's Payload Operations Control Center (POCC), and any other centers required to support the mission. Once cargo testing has been completed, the final ordnance connections are made, safing completed, and closeouts for flight performed.



IUS and TDRS closeout for flight in the PCR.

The cargo bay doors are closed and any requirements for late servicing, such as battery charging, will be accomplished through the Orbiter umbilicals as part of the total Shuttle countdown.

The other elements of the STS are now readied and the Shuttle is launched.

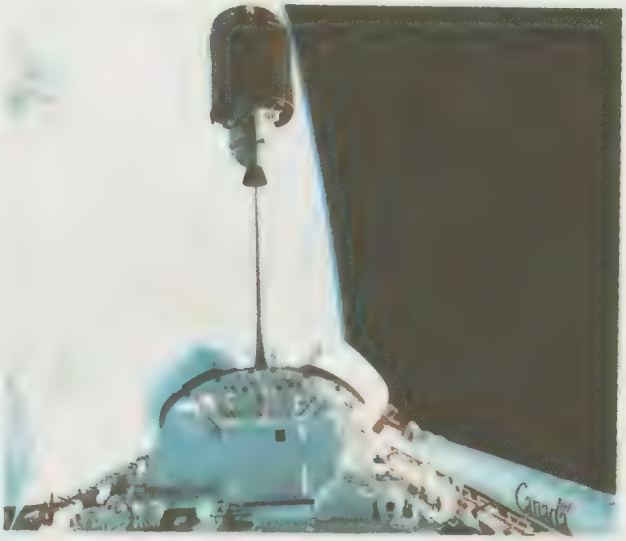
All elements of STS control are transferred to the Mission Control Center at JSC in Houston from the time the Space Shuttle has cleared the launch tower until the flight crew leaves the Orbiter after landing. For the duration of the mission, cargo-related transmissions are telemetered to the JSC and/or the user's POCC.

KSC Launch Control Center.

Above: STS launch.

Right: JSC Mission Control Center.

Orbiter as seen from the SPAS-01.



PALAPA-B being deployed.

POST LANDING OPERATIONS 11

After reentry and landing.

Crew egress.

Tow to OPF /payload removal.

Payload deintegration.

After the Orbiter lands at KSC and the crew egresses, the cargo bay environmental limits are maintained by exterior units that are attached while the Orbiter is on the landing strip and remain attached while it is being towed to the OPF for safing. Normal removal of returning payloads and airborne support equipment occurs in the OPF approximately 2 days after landing. Landing at a site other than KSC in the U.S. will require several days for the ferry flight to KSC in an environmentally uncontrolled Orbiter cargo bay before cargo can be removed. Upon removal from the Orbiter, equipment will be turned over to payload owners/operators for shipment to their respective facilities as soon as possible. Packaging and shipment are a user responsibility. If a contingency landing is made overseas, the payloads will be removed from the cargo bay and returned to KSC or the user's facility.

SECTION TWO: OPTIONAL vs. STANDARD SERVICES

II

Optional payload services are those tasks outside the scope of currently defined STS services. This guide does not apply to services for DOD payloads.

Optional payload-related launch site services are specific tasks performed in the user's behalf by NASA using existing internal or external capabilities. These tasks are outside the scope of currently defined standard STS services.

NASA will undertake any reasonable optional service that the user can adequately define and that NASA can capably perform. Considerations NASA must make when evaluating the capability to perform a requested payload-related optional service include interference with previously planned work; the extent of required modifications to equipment, facilities, or procedures; and the availability of alternate commercial support.

Normally, the service provided by NASA would utilize existing NASA in-house capabilities and/or existing contracted capabilities. If new capabilities are requested by the user and NASA agrees to develop the capability, the user/users will assume the full financial responsibility for development.

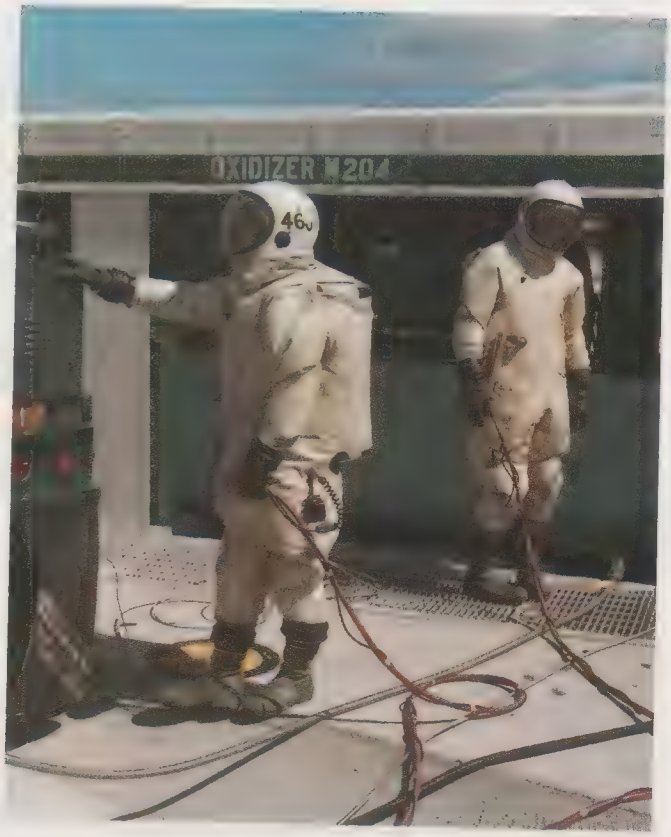
Optional launch site services consist of those STS services up to O&C/VPF cargo integration plus additional unique services through launch and landing including contingencies.

Launch site support services and facilities, above those standard services included in the basic price, are avaiable at KSC and the adjoining Cape Canaveral Air Force Station. Both are described in detail in the **KSC Launch Site Accommodations Handbook for STS Payloads**, K-STSM-14.1.

Launch site spacecraft processing facility assignments will be made by KSC based on user requirements. The price of the facility includes the operation and maintenance of the facility, janitorial support, office space, and utilities. Clean rooms are available in some facilities. The level of clean room support is individually priced as a function of the cleanliness specifications.

TYPICAL OPTIONAL SERVICES

- Use of hazardous operations Self-Contained Atmospheric Protective Ensemble (SCAPE) suits
- Ordnance and liquid propellants handling and storage
- Hazardous materials disposal service
- Communications in and between facilities
- Sampling and analysis
- Photographic services
- Equipment calibration
- Facility modification
- Use of payload processing facilities



SCAPE suit operations.

All support provided by NASA in a PPF is an optional service. A series of facility handbooks are available for information regarding payload accommodations.

a. K-STSM-14.1.1, **Facilities Handbook for Building AE**
b. K-STSM-14.1.2, **Facilities Handbook for Building AO**
c. K-STSM-14.1.3, **Facilities Handbook for Building AM**
d. K-STSM-14.1.3, **Facilities Handbook for Hangar S**
e. K-STSM-14.1.7, **Facilities Handbook for SAEF-2**
f. K-DPM-10.1.5, **Requirements Document for the Planned CHSF**

The appropriate PPF is scheduled for the payload for receiving, inspection, assembly, test, and checkout. An electrical ground support equipment station may be established to monitor and conduct checkout via hardlines and radio frequency (RF) as the spacecraft is processing through the KSC facilities.

Once the PPF operations have been completed, the payload must be transported to an HPF, if hazardous operations are required. If NASA performs this transportation, it is an optional service. If hazardous servicing is not required, the payload will go directly to the VPF for cargo integration operations.

All support provided by NASA in an HPF is an optional service. The DSTF, ESA-60A, SAEF-2, and the planned CHSF are the facilities in which hazardous servicing is conducted. See K-STSM-14.1.5, **Facilities Handbook for Delta Spin Test Facility**, and K-STSM-14.1.6, **Facilities Handbook for Explosive Safe Area 60**.

The payload organization will retain prime responsibility for the test, checkout, servicing operations, etc., of the payload while in the HPFs.

Once the preceding operations have been completed, the mated payload and carrier or payload are moved to the VPF via transportation provided by the payload organization.

All launch site support provided by NASA to payload arrival at the VPF airlock is an optional service. Subsequent activities are standard services unless otherwise identified.

TYPICAL STANDARD SERVICES

Vertical Processing Facility
Cargo Integration Test Equipment
Canister/Transporter Operations
Pad Operations

The CITE operations are included as a standard service. Payload-unique dedicated time in the VPF, except as provided as the payload share of the normal 10 hours allocated to the cargo, must be negotiated as an additional optional service.

When all the interface verification tests have been completed, the total manifested integrated cargo is placed in the KSC Multiuse Mission Support Equipment (MMSE) canister for transportation to the RSS at the pad in the vertical mode as a standard service.

All activities at the pad are a standard service unless identified as a payload-unique requirement. Eight hours of cargo-peculiar serial time in the RSS prior to arrival of the Orbiter at the pad can be made available as a standard service. There will be a serial impact charge as an optional service for additional cargo-unique testing unless done in parallel with NASA operations on a non-interference basis. After payload insertion into the Orbiter cargo bay and completion of interface testing, eight hours of cargo-peculiar serial time can be made available as a standard service.

PRICING DETAILS

Further details covering the pricing of optional services are provided in the **Payload-Related Optional Launch Site Services Guide**, K-CM-16.1

SECTION THREE: QUESTIONS & ANSWERS III

Sections I and II may have stimulated a number of questions in your mind, and certainly a number of payload-unique questions will arise during planning for your mission. The following is a representative sample of the 'most asked' at early Payload Ground Operations Working Group (PGOWG) meetings and Technical Interchange Meetings. They provide a good introduction to the type of questions that will arise during the planning sessions for your processing at KSC.

Q: Who at KSC is responsible for seeing that my payload requirements are met?

A: The LSSM is the customer's primary point of contact at KSC for programmatic support from initial planning to launch through landing. The LSSM works with the Launch Site Support Team (LSST) on behalf of the user.

The LSSM is a member of the Cargo Test and Checkout Team headed by the Cargo Manager. The Cargo Manager is responsible for overall processing activities from arrival at the VPF through launch and post landing.

Q: What are the security requirements for personnel access to the various processing facilities?

A: KSC and CCAFS are restricted areas and require proper clearance and badging for unescorted areas. The KSC Industrial Area and all cargo processing facilities are within a fenced area under 24-hour guard. Access to KSC and CCAFS must be coordinated with the LSSM and the NASA Security Office. Foreign payload customers will also require formal accreditation by NASA Headquarters before access to KSC or CCAFS will be granted. Persons requiring unescorted access into controlled payload processing facilities must meet established screening requirements as well as safety training requirements. The NASA/KSC Security Office must complete an investigation for all individuals requiring unescorted access to the controlled areas. Exactly what is expected from the customer is explained in detail in the Launch Site Support Plan (LSSP). Be aware that access clearances you may have for other NASA centers may not be valid at KSC.

Temporary access control setup for the TDRS receiving in the VPF.

Q: What KSC meetings will the customer be expected to attend in addition to the PGOWG?

A: Ground Operations, Ground Safety, Operations and Maintenance Instructions (OMIs), and Cargo Readiness reviews and Test Team meetings.

Q: What information is expected from the customer for KSC documentation?

A: All of your requirements for support at KSC such as forklifts, offices, data lines, fluids and gases must be documented. Any special access or cleanliness requirements and the details of all procedures you plan to perform at KSC must be submitted.

Q: What is being done about contamination control at the processing facilities?

A: A **KSC Cargo Contamination Control Plan** (K-STSM-14.2.1) sets environmental and cleanliness level requirements and operational and maintenance requirements.

QUESTIONS & ANSWERS

The Cargo Facility Contamination Control Implementation Plan (KCI-HB-5340.1) is available and addresses cargo facility requirements.

Q: What is expected from the customer during the Ground Safety Reviews?

A: Ground Safety Reviews are covered in detail in SAMTO HB S-100/KHB 1700.7, **Space Transportation System Payload Handbook.** This handbook identifies the minimum NASA ground processing requirements, safety policy, and criteria for STS payloads and associcated GSE.

Q: Will KSC arrange for living quarters and transportation during my stay in Florida while payload processing is taking place?

A: No. You will be provided with a list of accommodations available in the area, including car rental agencies. A car will be necessary getting to and from KSC and can also be useful in going from one facility to another on the Center.

Q: What standard types of fluid and electrical services are provided during integration and checkout?

A: Several types of water are available, including utility water and potable water in most locations. Deionized, demineralized, and distilled water are also available.

Labs and integration areas are provided with shop air. In addition, military-specified argon, helium, hydrogen, and nitrogen are available on request. Other gases are provided, if requirements are identified early.

Standard power at KSC is 60-Hz at 120V, single phase. Limited amounts of 120/208V, 3-phase power are also available. Your LSSM has the detailed capability design information such as this.

Q: What about 50-Hz power?

A: While 60-Hz power is standard in the United States, a limited amount of converter-provided 50-Hz power is available at KSC.

Q: Will I be able to troubleshoot my payload during processing?

A: Yes, within the normal operations schedule and safety parameters. You should bring with you all necessary drawings, specifications, and other documentation required to perform this activity.

Q: Is there any single, overriding consideration that will help ensure a cost-effective and trouble-free processing flow for my payload?

A: Yes. Keep ground operations, as well as flight operations, in mind during payload design and furnish your requirements as early as possible. A number of ground processing design factors can, and should, influence payload design. You should make every effort to ensure accessibility of such items as batteries, film and tape packs, and instrument covers. The fewer requirements for test and checkout, the better. Active systems should be as self-contained as possible and accommodate nominal launch delays.

Many such considerations will come to light during discussions with your LSSM and during your planning sessions here at KSC and at other NASA centers.

Q: Are there additional reference documents available to help someone new to KSC and the STS program?

A: Yes. Both the **STS User Handbook** (NASA Headquarters) and the **Launch Site Accommodations Handbook for STS Payloads** (K-STSM-14.1) provide a good introductory level of detail. In addition, there are a number of facility and equipment handbooks and management and design guidelines. Your LSSM will help you select the

QUESTIONS & ANSWERS

path of least-documentation based on your needs.

Q: What are the regulations for transporting hazardous items by air?

A: Shipments by air must conform to the appropriate requirements of the following internationally recognized documents: Section 3 of the **International Air Transport Association Manual**, Chapter 1 of the **International Civil Aviation Organization** manual and Title 49 of the **Coded Federal Regulations.** If further technical assistance is required, you may contact the KSC Transportation Branch, SI-SAT-21, Packaging Engineer at the following number: Area Code (305) 867-3290 or 3240.

Q: How will I know all of my requirements have been met prior to arriving at KSC?

A: The LSSM will document your requirements in a Program Requirements Document (PRD) which will be distributed for approval of each requirement. The requirements and approvals will be documented in the PRD/PSP (Program Support Plan). The PRD/PSP is then incorporated into the LSSP to show all equipment and services NASA will supply you. The LSSP will also show whether this is a standard or an optional service and will identify any service which cannot be performed.

Q: How much support equipment can I bring to KSC with my payload?

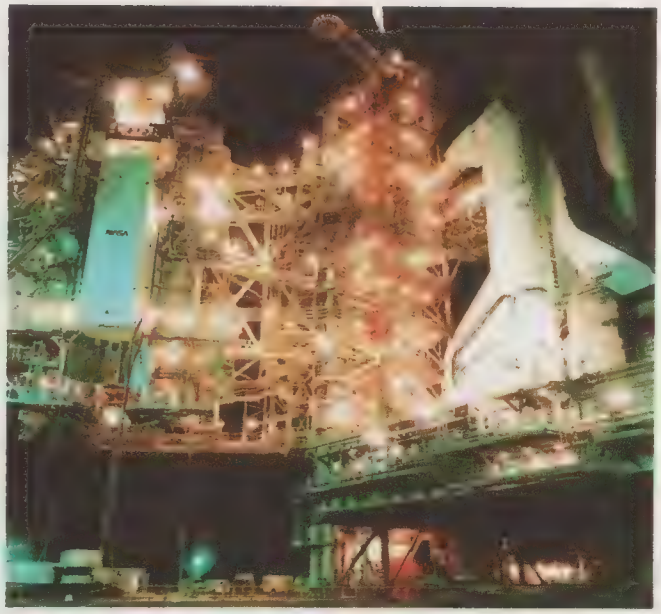
A: There is no set limit as to how much GSE you may bring. However, the majority of your GSE should be designed to work remotely to the payload either by RF or hardline so that it may remain in the PPF. The area on the VPF workstand levels and the PCR levels is limited and must be shared among the users.

Q: Will KSC furnish office space for my use?

A: Yes. A limited amount of office space is available, primarily located at the PPFs. Your requirements for offices and furniture must be documented in the PRD.

Q: How will a launch delay for the Space Shuttle affect my payload?

A: Humidity and temperature controls in the cargo bay are constantly maintained; however, in the event of a lengthy delay (greater than 24 hours), time-critical middeck payloads (e.g., biological specimens) may be removed to ground laboratories for necessary attention. Payload support subsystems, such as batteries and closed-loop gases, should be designed with a reasonable shelf life for short on-pad delays. These same systems should be easily serviced in the vertical configuration on the pad in the case of longer delays.



Contingency cargo removal at the pad during night shift operations.

Q: What data reduction capability is available during payload integration and checkout?

A: Little, if any, data reduction will be available for payload support. In effect, KSC will supply the raw data to the user for his own reduction.

Q: Can CITE testing be waived? Can CITE tests be run in both cells at the same time?

QUESTIONS & ANSWERS

A: CITE testing can be waived by negotiating with KSC and JSC. CITE testing can only be conducted in one cell at a time.

Q: What are vertically processed payloads?

A: Payloads that are inserted into the Orbiter cargo bay at the pad because they contain hazardous elements that preclude installation in the OPF. These primarily consist of fueled spacecraft and upper stages, or spacecraft and upper stages that require fueling at the pad.

Q: What is off-line/on-line?

A: Off-line is an activity conducted independently of any STS element and normally conducted in a separate facility as well. PAM-D to payload mating in the ESA-60A is considered off-line payload. On-line payload activity is one which involves another payload or an STS element such as the Orbiter, Remote Manipulator System, SRB, or ET.

The SPAS-01 payload beginning on-line operations in the Orbiter bay.

Q: How do I tell KSC personnel how to test my payload?

A: Only the testing that involves more than one payload or a part of the STS will be done by KSC. Testing involving only your payload (stand-alone testing) will be done by your personnel. Your requirements for testing by KSC will be documented in the Operations and Maintenance Requirements Specifications Documents. These requirements will then be transformed, with your help, into OMIs which are step-by-step procedures for payload testing.

Q: Does KSC provide clean room facilities for work on my payload?

A: Yes. Clean rooms and laminar flow work areas are available. The facilities handbooks and the **KSC Cargo Contamination Control Plan** (K-STSM-14.2.1) contain details of cleanliness levels and room layouts.

Q: What determines the cargo element delivery date to the VPF?

A: An assessment of operations at the VPF and pad is made and a schedule is worked backwards from the launch date.

Q: Will my spacecraft be contaminated by the other cargo elements?

A: NASA provides debris shields at the top of the payload stack and between payloads in the VPF and the Orbiter bay prior to payload bay door closure in order to reduce contamination. Your LSSM will furnish any additional information.

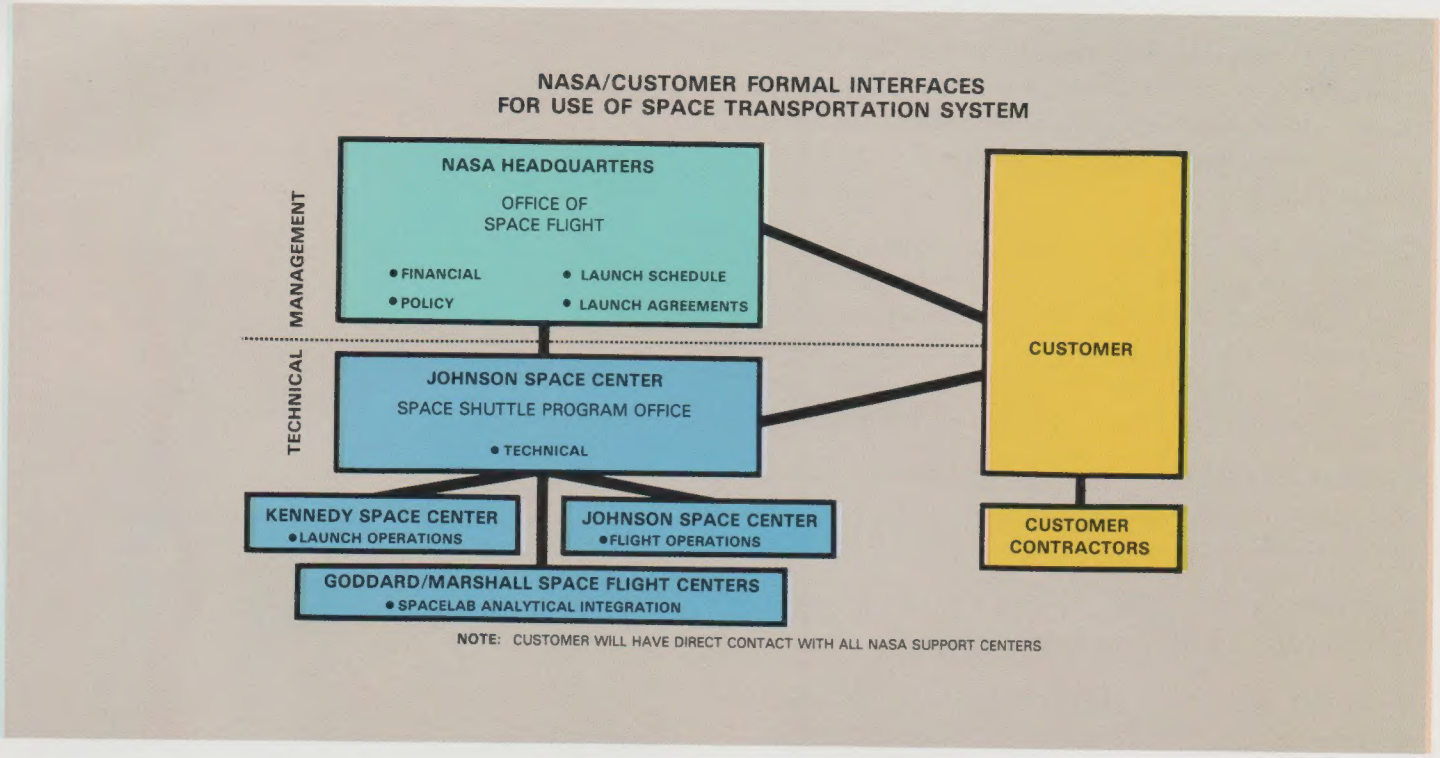
Q: What is the environment in the Orbiter bay with regard to temperature, humidity, and cleanliness?

A: The conditions in the bay after payload bay door closure at the pad are controllable within specified ranges. The following are nominal conditions existing from payload bay door closure to GN2 purge switchover:

Temperature 70 $\pm$ 2° F, humidity approximately 26%, and cleanliness just under Class 5000. After switchover of purge air to GN2 or GN2 to air in the countdown: Temperature variations of $\pm$15° F can occur for the first 15 minutes followed by $\pm$5° F until one hour has elapsed. Normal controllable limits after stabilization are $\pm$2° F. Humidity will drop to 0% when purging with GN2.

SECTION FOUR: PLANNING AHEAD

IV



In this guide, we have presented an introduction to the basic steps involved in processing your payload and at the same time identified some of the more important considerations that will help you during the ground integration phase of your flight. In essence, there are two areas in which STS users can participate prior to arrival at KSC to help ensure trouble-free and economical ground processing of their payloads.

First is a working knowledge of launch site capabilities. This will be developed through discussions with your LSSM, through documentation he will supply, and during meetings here at KSC that you or representatives for your payload will attend.

This will give a better understanding of some of the restrictions and limitations imposed on STS payloads by preflight processing and may provide useful information for the final design of flight hardware and support subsystems.

Second, there is a need for early identification of payload requirements that may affect processing at the launch site. Knowledge of the safety aspects and responsibilities is especially important and can be better understood as a result of your review of KHB 1700.7, **Payload Ground Safety Handbook.** These requirements may be identified by you as they become apparent, or they may come to light as a result of KSC analysis of your payload design and test and checkout needs. In either event, their timely satisfaction will depend on information supplied by you to your LSSM.

IN closing, it should be noted that there will be no 'final approach' to the processing of Space Shuttle payloads. Facilities, equipment, and procedures at KSC will constantly evolve and mature in response to advances in the Shuttle vehicle as well as in the nature of the payloads themselves. Larger and more complex satellites, retrieval missions, and interplanetary spacecraft will all impose new requirements on the STS program in general and on launch site support in particular. NASA has already begun study on spaceport development into the 21st century, and by working together, we can ensure that the STS program will continue as an efficient and profitable venture for all concerned.

APPENDIX A
GLOSSARY OF SELECTED TERMINOLOGY

AFT FLIGHT DECK - That portion of the upper deck of the Orbiter cabin that overlooks the cargo bay and contains the mission-specialist and payload-specialist stations.

AIRBORNE SUPPORT EQUIPMENT - That flight equipment necessary to support the deployment of a payload such as booster/cradle assemblies, spin tables, sun shields, and scientific instrument flight support equipment installed in the Orbiter and returned to earth.

CARGO - The total complement of payloads (one or more) on any one flight. Cargo includes everything contained in the Orbiter cargo bay plus other equipment, hardware, and consumables located elsewhere in the Orbiter that are user unique and are not carried as part of Orbiter payload support.

CARGO ELEMENT - The combination of spacecraft/upper stage/ASE which makes up a single piece of STS cargo.

EXPERIMENTER - A user of the STS whose experiment is part of a total flight cargo.

GROUND SUPPORT EQUIPMENT - Nonflight equipment required for the handling, servicing, inspection, testing, maintenance, alignment, and repair of a payload or payload subsystem, or component thereof. This may include equipment required to support another item of GSE.

MISSION SPECIALIST (MS) - A Shuttle crewmember responsible for coordination of overall payload/STS interaction. The MS will have prime responsibility for experiments to which no payload specialist is assigned and/or will assist the payload specialist to support another item of GSE.

PAYLOAD - The total complement of specific instruments, space equipment, support hardware, and consumables carried in the Orbiter (but not included as part of the basic Orbiter payload support) to accomplish a discrete activity in space.

PAYLOAD OPERATIONS CONTROL CENTER - The NASA focal point for payload operations and control during a Space Shuttle mission, containing the necessary equipment, software, and personnel needed to evaluate and control the performance of the payloads during operations.

PAYLOAD SPECIALIST (PS) - A Shuttle crewmember responsible for the operation and management on-orbit of specific experiments or payload elements. The PS may or may not be a career astronaut.

SCIENTIFIC INSTRUMENT - A system of hardware and software for performance of a scientific or applications investigation.

SPECIAL STRUCTURE - Generally, any scientific instrument carrying structure used in the cargo bay that is not an MPESS, GAS canister, or standard satellite/upper stage cradle arrangement.

UPPER STAGE - A propulsion unit used with a payload when required. One or more of these units may be used to provide the additional velocity required to place a payload in the desired orbit or trajectory. Also, a propulsion system that is used to provide mid-course trajectory corrections, braking maneuvers and/or orbital adjustment.

APPENDIX B
COMMON ACRONYMS & ABBREVIATIONS

AFD	Aft Flight Deck
CCAFS	Cape Canaveral Air Force Station
CHSF	Cargo Hazardous Servicing Facility
CITE	Cargo Integration Test Equipment
DSTF	Delta Spin Test Facility
ESA	Explosive Safe Area
ET	External Tank
GAS	Getaway Special
GSE	Ground Support Equipment
HPF	Hazardous Processing Facility
IUS	Internal Upper Stage
JSC	Johnson Space Center
KSC	Kennedy Space Center
LCC	Launch Control Center
LPS	Launch Processing System
LSSM	Launch Site Support Manager
LSSP	Launch Site Support Plan
LSST	Launch Site Support Team
MLP	Mobile Launcher Platform
OPF	Orbiter Processing Facility
PAM	Payload Assist Module
PAM-D, D-11	(Upper Stage Delta Class Payload)
PCR	Payload Changeout Room
PGOWG	Payload Gound Operations Working Group (Meeting)
PGHM	Payload Ground Handling Mechanism
POCC	Payload Operations Control Center
PPF	Payload Processing Facility
PRD	Program Requirements Document
PSP	Program Support Plan
RF	Radio Frequency
RSS	Rotating Service Structure
SAEF-2	Space Assembly & Encapsulation Facility
SMAB	Solid Motor Assembly Building
SRB	Solid Rocket Booster
STS	Space Transportation System
TOS	Transfer Orbit Stage
TSM	Tail Service Mast
VAB	Vehicle Assembly Building
VPF	Vertical Processing Facility
VPHD	Vertical Payload Handling Device

NAME	ADDRESS/MAIL CODE	PHONE